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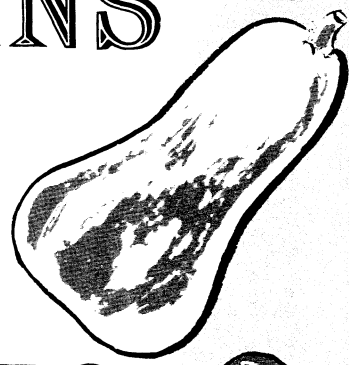
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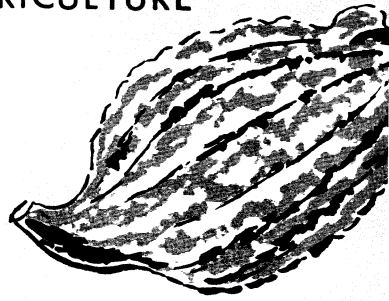
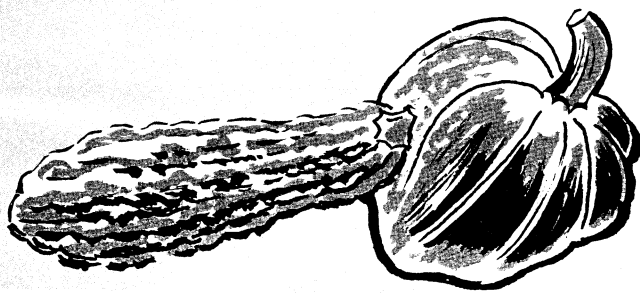


GROWING PUMPKINS AND SQUASHES



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Pumpkins and squashes are among the few food plants that are natives of America. They are known to have been used by the North American Indians before the advent of the European settlers. Both are nutritious and valuable vegetable crops and have many and varied uses. If properly handled and stored, a supply may be had from midsummer to late spring. In addition to their use as fresh vegetables, a large tonnage of pumpkins and squashes is canned each year; the canned product is used largely for pie making. In acreage and crop value the pumpkins and squashes are among the less important vegetable crops.

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GROWING PUMPKINS AND SQUASHES



Prepared by Crops Research Division and Entomology Research Division,
Agricultural Research Service

Pumpkins and squashes can be grown for local use in all parts of the United States, but their large-scale commercial production is limited to States where growing conditions are most favorable.

The States having the greatest acreage in pumpkins are Illinois, New Jersey, California, Indiana, New York, Ohio, Michigan, Pennsylvania, Iowa, Colorado, Delaware, and Texas. Those growing the largest acreage of squashes are Florida, California, Texas, New York, Georgia, New Jersey, Massachusetts, Michigan, South Carolina, North Carolina, Maine, and Oregon. The relative position of the States may vary from year to year because of season and market conditions.

REQUIREMENTS

Almost any good, well-drained garden soil will grow pumpkins and squashes; these crops will not tolerate a wet, poorly aerated soil. The soil should be well supplied with organic matter. A soil capable of retaining moisture is desirable, especially in localities where rainfall is likely to be deficient.

A soil of medium texture is best, but good yields can be produced on heavier and lighter soils if they are properly handled and well fertilized. A light rich soil that warms up rapidly is desirable for growing summer varieties for the early market.

Pumpkins and squashes do best on soils that are slightly acid or nearly neutral; good yields are produced on some of the slightly alkaline soils of the West. Avoid extremely acid soils.

VARIETIES

Pumpkins and squashes belong to three species of the genus *Cucurbita*—*Cucurbita pepo*, *C. maxima*, and *C. moschata*. Some botanists distinguish a fourth species, *C. mixta*.

In popular usage of the names "pumpkin" and "squash," no distinction is made as to species. Some varieties of each of the species are called pumpkins and some are called squashes.

Generally, if the fruits are eaten in the immature stages, as with the Crooknecks, Straightnecks, Bush Scallops, and Cocozelles, the plants

are called summer squashes. If they are not harvested until maturity and the fruits have hard rinds making them suitable for winter storage, they are called winter squashes. The rind of most pumpkins is not very hard even at full maturity.

Under favorable conditions most of the summer varieties of squash produce the first usable fruits in 7 to 8 weeks from planting and continue to bear for several weeks. The winter varieties of squash, and the pumpkins, require 3 to 4 months to mature a crop, and a single planting is normally harvested all at one time instead of successively like the summer squashes.

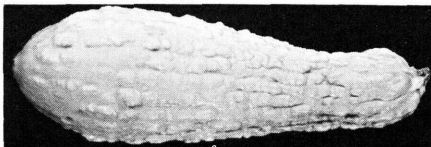
Squashes

Summer Squashes

The most widely grown of the summer squashes are the Crookneck, Straightneck, and Scallop types. There are several varieties and strains of each.

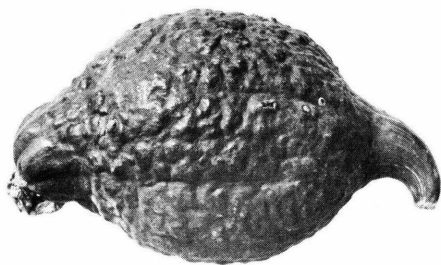
The Yellow Summer Crookneck is a popular variety of the Crookneck type.

The Straightneck type, which is similar to the Crookneck except in shape of the neck, is popular because the straight-necked fruits are more easily handled in packing for shipment. One of the best of these is Early Prolific Straightneck.



BN 1235

Figure 1.—A mature fruit of Early Prolific Straightneck squash.



BN 1234

Figure 2.—Green Hubbard squash.

Of the Scallop type there are white, yellow, and striped-skinned varieties. The white ones are the most popular; Early White Bush Scallop is the leading variety.

The Vegetable Marrows are a group that includes both bush and vining forms. Long White is one of the best of the bush form. The English Vegetable Marrow is a good strain of the vining form.

The Cocozelle and Zucchini, bush summer squashes of the Vegetable Marrow type introduced from Italy, are grown extensively for the early market. Dark-skinned strains of Zucchini have been introduced since 1955. Caserta is a popular variety of the Cocozelle type; it is early and prolific.

Winter Squashes

Among the best of the late-winter squashes are the Boston Marrow, Delicious, Marblehead, Buttercup, Butternut, Table Queen, and varieties of the Hubbard type. The Boston Marrow should not be confused with the Vegetable Marrows already mentioned.

The Delicious is regarded by many as the finest of all squashes in quality. The fruits are top-shaped,

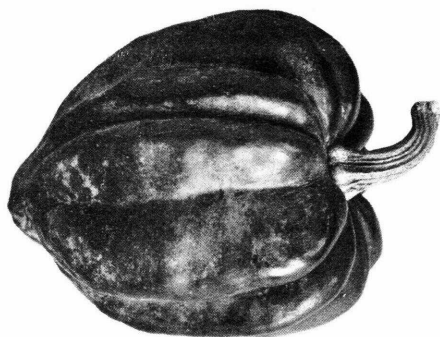
tapering to the blossom end. There are both green and golden varieties of the Delicious type. Boston Marrow is similar to Delicious.

Buttercup and Butternut are small varieties of very high quality.

Table Queen, or Acorn, is a popular winter type. It is prized for its excellent baking qualities and for its small size, which makes it convenient for cutting in two pieces and serving as individual portions. The shell is hard and slightly ridged longitudinally. The skin of the immature fruits is dark green but turns to an orange, yellow, or copper color in storage after full maturity.

There are several varieties of the Hubbard type, including Golden Hubbard, Blue Hubbard, Warty Hubbard, and Green Hubbard. The Hubbards vary chiefly in size, color, and time of maturity. The Green is probably the most popular of the dark-skinned Hubbards. The Golden, which has a rich, orange-colored skin, is earliest of the Hubbards. The Blue and Warty, late-winter squashes, produce the largest fruit; they weigh 12 to 18 pounds. The Hubbards are among the better of the squashes for winter storage.

The largest of the squashes, sometimes listed as a pumpkin, is Mam-



BN 1233

Figure 4.—A mature fruit of Table Queen squash.

moth, also called Mammoth Chili and King of the Mammoths. The fruits may grow to a very large size and are often found in exhibits at county fairs. The flesh is too coarse and poor in quality for general table use. Mammoth is grown chiefly for stock feed.

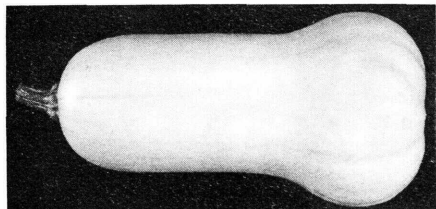
Pumpkins

The best and most popular of the pumpkin varieties include Sugar, Connecticut Field, Cheese, and the Cushaws. Kentucky Field, a variety similar to Cheese, is grown in some localities.

Sugar is one of the smallest of the pumpkins. Its flesh is fine grained and sweet. It is a good variety for pie making. Sugar pumpkins are frequently planted in cornfields in the Northeastern States. The golden-yellow fruits are seen in the fields after the cornstalks have been cut.

Connecticut Field, Cheese, and Golden Cushaw are grown extensively for canning.

The Cushaw type produces large, elongated fruits, the necks of which



BN 1236

Figure 3.—A mature fruit of Butternut squash.



BN 1237

Figure 5.—Connecticut Field pumpkin.

are solid, free from seed cavities, and often curved. The seed cavity of the Cushaws is confined to the bulbous apex. There are several strains of the Cushaw pumpkin. Among them are Golden, Green Striped, and White, which differ in color, size, and length of neck. The Green Striped is the most popular of the Cushaws.

The large-fruited varieties such as Mammoth, Connecticut Field, Cheese, and Cushaws are among the varieties most grown for stock feed.

Varieties for Canning

Both pumpkins and squashes are used for canning. The canned products are similar and both are used for pie making. Some of the canned product is a blend of pumpkin and squash varieties.

The large-fruited and heavy-yielding varieties that have yellow or light-colored rinds and flesh of good texture and high content of solid matter are the most desirable for canning. The green-skinned varieties are most difficult to prepare

for canning because all green tissue must be removed to avoid off-color in the canned product.

To meet the requirements of the commercial canning trade a variety must be a heavy yielder, fruits must have flesh of deep orange-yellow to orange color, and the flesh must be free of fiber and coarseness.

Squashes and pumpkins for canning are generally grown under contract with the canning company. The company usually supplies the seed of the variety it desires. Consult the canner before planting a large acreage of pumpkins or squashes with the expectation that the canning company will handle the crop.

Among the pumpkin varieties most used for canning are Connecticut Field, Cheese, Kentucky Field, and Golden Cushaw. Of the squashes, Boston Marrow, Delicious, and Golden Hubbard are the varieties most used. Connecticut Field and Cheese are favored as canning sorts throughout the Middle West. Boston Marrow squash and Cushaw pumpkins are popular with eastern canners. Kentucky Field is a popular canning pumpkin in the West.

MIXING OF VARIETIES

In pumpkins and squashes, the male and female organs are borne in separate flowers on the same plant. The flowers are largely insect pollinated. This flowering habit results in much intervarietal crossing where different varieties of one species are grown close to each other.

If you wish to save seed for planting purposes or maintain a true-breeding seed stock of a squash or pumpkin variety, grow the variety alone, with a quarter-mile or more distance as a barrier between it and other varieties.

Not all varieties of pumpkins and squashes will cross-pollinate when grown in the same field. All the varieties of a species, however, will mix or cross when grown in the same field. That is, all the varieties of *C. pepo* can cross-fertilize each other; all the varieties of *C. moschata* can cross-fertilize each other; and all those of *C. maxima* can cross-fertilize each other.

There is little probability that varieties of *C. pepo* will mix with varieties of *C. maxima*. The varieties of *C. moschata* may mix with varieties of either *C. pepo* or *C. maxima*, but this is not common.

Pumpkins and squashes will not mix with cucumbers, watermelons, or muskmelons.

CULTURE

Soil Preparation

Like other cucurbits, squashes and pumpkins have large but shallow root systems. The root growth is very rapid and extensive in the upper 6 to 8 inches of soil. Therefore the upper layers of soil should be thoroughly prepared and well fertilized for best results.

Pumpkins and squashes respond to liberal applications of fertilizer unless the soil has been previously heavily fertilized. Well-decomposed stable manure is best and should be applied at the rate of 10

tons or more per acre when it can be obtained at a reasonable cost. Heavy applications of manure should be broadcast and plowed under in the fall. If the manure supply is limited to a few tons per acre, it can be used most efficiently by working it into the hills before planting. Manure applied in the hills should be well decomposed and thoroughly mixed with the soil. Manure that is not well rotted, especially strong manure like poultry or sheep, should not be applied in the hills at planting time.

Soils vary so greatly in their fertilizer requirements that little specific advice can be given as to the best commercial fertilizer combination to use.

Most of the eastern soils respond to an application of complete commercial fertilizer in addition to animal manure.

Superphosphate at the rate of 1,000 to 1,500 pounds per acre can be expected to return a profit, especially in the Middle West, where the soil is likely to be deficient in phosphorus. In the irrigated sections of the West, where the humus content of the soil is low, animal manure supplemented with a nitrogen fertilizer is likely to give the best results.

In general, 500 to 1,000 pounds of a complete fertilizer containing 4 to 6 percent nitrogen, 8 to 10 percent phosphoric acid, and 5 to 8 percent potash can be used profitably in growing pumpkins and squashes. Fertilizers having a 5-10-5 analysis are widely used and their use can generally be recom-

mended. In light soils where nitrogen is lost rapidly, one or two side dressings with nitrate of soda or ammonium sulfate at the rate of 100 to 150 pounds per acre may be profitable.

Acid soils should be limed as indicated by a lime-requirement test.

Planting

Like other cucurbit crops, pumpkin and squash are somewhat difficult to transplant and are seldom started under glass for transplanting to the field. Only the summer varieties can be transplanted profitably, and then only when an early market means increased profits. High prices are often obtained from an early crop of such summer squashes as the Straightnecks, Scallops, and Cocoselles. Nothing is gained from transplanting the late or main crop of pumpkins and squashes, except in districts having a very short growing season.

If squashes are to be transplanted, do not remove the soil from the roots and do not disturb the roots any more than you have to. Plant the seed early in individual containers in hotbeds or under other protection. Seedlings can then be transplanted to the field with a minimum of root disturbance. Pint or quart wooden, paper, or other fiber containers are good for growing transplants of early squashes.

Pumpkins and squashes are warm-season crops and are sensitive to frost. Delay planting until the soil has warmed up and is in good condition for germination and air temperatures are favorable for growth of warm-season crops.



BN 1238

Figure 6.—Hill of summer squash started in a 1-quart strawberry box.

Pumpkin and squash seed may decay before germinating if planted in wet, cold soil.

The bush and small-vine varieties may be planted in hills as close as 4 by 5 feet, but the varieties having long running vines should be spaced 8 to 12 feet apart each way, the distance depending on the growth habit of the variety and the fertility of the soil.

The seed is sometimes planted in drills rather than in hills, and the seedlings are thinned to about 4 feet apart in the row. This gives each plant a better chance for development.

The amount of seed required to plant an acre varies from 2 to 4 pounds, the amount depending on the size of the seeds and the planting distances. Plant plenty of seed and thin the plants to not more than three to a hill after danger from early attacks by insects is past. Cover the seed to a depth of about

1 inch. It may be covered a little deeper in light soils than in heavy soils.

Pollination

All pumpkins and squashes require cross-pollination—the transfer of pollen from the anthers of the male flower to the stigma of the female flower. No pollination means no fruit. Inadequate pollination results in reduced yield and misshapen fruit. Bees are the primary pollinators. If they are not abundant in the field at flowering time, hives of them should be moved into or near the field. Protect the bees and encourage their presence in the field for biggest yield of best shaped fruit.

Cultivation

Cultivation should be shallow to avoid injuring the shallow roots. It is doubtful whether these crops should be cultivated more than is necessary to keep down weed growth. The removal of weeds by means of sweeps that cut just under the surface is preferable to using implements that stir the soil to greater depth.

Chemical Control of Weeds

Weeds not only compete with pumpkins and squashes for sunlight, moisture, and nutrients, but also may harbor insects, nematodes, and diseases. Occurrence of weeds in the planting can reduce yield and quality of the crops.

Problems of weed control occur at emergence, when the crop plants are too small for effective cultivation,

and during midseason, when the spreading squash or pumpkin vines interfere with mechanical cultivation and hand weeding.

Annual weeds that are major pests in pumpkin or squash plantings are lambsquarters, pigweed, crabgrass, goosegrass, barnyard grass, and fall panicum. Certain perennial grasses, including bermudagrass, nutgrass, and quackgrass, also are serious pests in some areas.

Do not plant pumpkins or squashes in fields that are heavily infested with perennial broadleaf weeds or weed grass.

Soil fumigants such as SMDC,¹ DMTT,² and methyl bromide may be used as pre-planting soil treatments to control many weeds and weed grasses. However, the high cost of these materials limits their use to small areas.

Many of the annual weeds that emerge with the crop can be controlled with NPA³ sodium salt applied immediately after seeding. It should be applied at the rate of 4 pounds of the active chemical—mixed with 40 gallons of water—per acre. NPA is safe to use as directed on plantings of squash varieties described in this publication. Before using it on plantings of other varieties, consult your county agricultural agent or your State agricultural experiment station regarding the tolerance of the varieties to the chemical.

Herbicides that are applied to the soil are most efficient when the soil

¹ Sodium-N-methyldithiocarbamate.

² 3,5-dimethyltetrahydro - 1,3-5,2H - thiadiazine-2-thione.

³ N-1-naphthylphthalamic acid.

is moist and warm enough to cause rapid germination of weed seeds; the weeds are killed as they germinate. A light irrigation immediately after treatment will improve weed control. Treatment when the soil is dry or cold usually is disappointing.

When using herbicides, follow the directions on the label. (See "Precautions," page 20.) Treatments at times other than those recommended, or at rates in excess of those recommended, may cause injury to the crop or may leave harmful residues in or on the harvested product.

CURING AND STORING

Of the squashes, only the hard-shelled varieties are adapted for long storage. Some of the pumpkins, such as Table Queen, Large

Cheese, and Small Sugar, can be kept from harvest in autumn until the end of December if properly handled.

Both squashes and pumpkins should be well matured before harvest and storage. Handle them carefully; cuts and bruises in the rind are open to decay organisms that may cause a great deal of loss from rot in a short time. Under proper conditions, wounded areas on both squashes and pumpkins are capable of healing over by producing cork tissue, which gives protection against the entrance of rot organisms. This protecting tissue seems to develop best at a relatively high temperature and in a moist atmosphere.

Good results have been obtained by curing pumpkins and squashes with stove or other artificial heat at a temperature of 80° to 85° F., with



Figure 7.—Hubbard squashes stored on shelves.

BN 1239

a relative humidity of about 80 to 85 percent, for 10 days after harvesting. At the end of the 10-day period the humidity should be lowered to about 70 percent and the temperature kept between 50° and 60°.

It is essential that the surface be kept dry during the storage period. Temperatures above 60° tend to keep the respiration rate too high, and considerable loss in weight results. Excessive loss of moisture or solids impairs the quality.

Any dry place where the proper temperature can be maintained is suitable for the storage of squashes and pumpkins. They keep best when not piled on top of each other. A good method is to provide shelves where they can be spread out in a single layer with a small space between the fruits. Storing them in this manner greatly reduces the chances of loss from decay.

DISEASES

The diseases that most commonly affect pumpkin and squash are damping-off, downy mildew, powdery mildew, scab, bacterial wilt, fusarium root rot, gummy stem blight, or black rot, fruit rots, and virus diseases.

Following are ways in which you can prevent or reduce losses from disease:

- Rotate crops; do not plant cucurbits in the same field oftener than once every 3 years.
- Disinfect seed and treat it with a fungicide before planting.
- Spray or dust the crop with a fungicide regularly.

- Apply insecticides as needed for control of disease-carrying insects.
- Keep fields and surroundings free of weeds.
- Destroy all diseased plants.
- Clean up and burn all plant material after harvest.

Description of Diseases

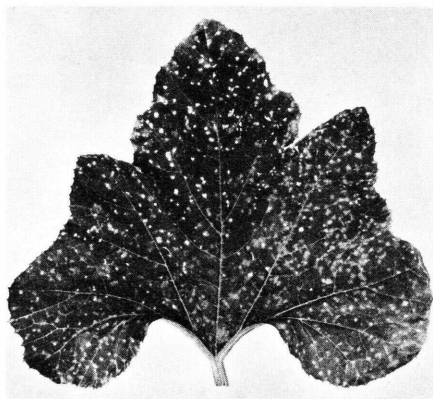
Damping-Off

Damping-off is a soil-borne disease that is distributed throughout the United States. It causes seed to decay in the soil or causes young plants to collapse and die. To reduce losses from damping-off, treat the seed with a protectant fungicide. (See p. 14.)

Downy Mildew

Downy mildew is a foliage disease that damages pumpkins and squashes in the Atlantic Coast and Gulf States. This disease does not attack fruits directly, but it weakens the vine and causes a reduction in size and number of fruit.

Damage is most frequent on the older leaves. Small yellow spots ap-



BN 1194

Figure 8.—Squash leaf showing the spotting characteristics of downy mildew.

pear on the leaves; the leaves dry, curl, and die.

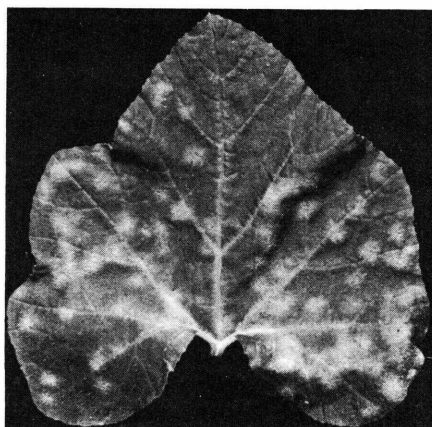
Unless it is controlled, downy mildew spreads rapidly through a field. To protect plants, apply dusts or sprays of zineb, nabam with zinc sulfate, maneb, or fixed copper fungicides. (See pp. 14 and 15.)

Powdery Mildew

Powdery mildew is a disease attacking foliage and stems of cucurbits. It causes serious losses in the southwestern United States.

The first symptoms of the disease are small white patches of fungus growth that are most abundant on older leaves. The patches grow in size until they may form a white, powdery growth that covers most of the leaf and stem. Older leaves may die.

Powdery mildew is most severe in cool, moist weather; it is most prevalent toward the end of the growing season.



BN 1195

Figure 9.—Squash leaf showing white growth of the fungus that causes powdery mildew.

For control, apply dinocap (Kathane)⁴ or sulfur dust.

Scab

Scab is prevalent in New England and southward to North Carolina. It attacks the fruits of summer squash, particularly Crookneck and Yellow Straightneck. It causes sunken brown spots on the fruits; a gummy substance oozes from these spots. In moist weather, the spots are covered by grayish-olive fungus growth. Some small, brown spots may appear on leaves and stems. Scab damage is worst in cool, moist weather.

To reduce losses from scab:

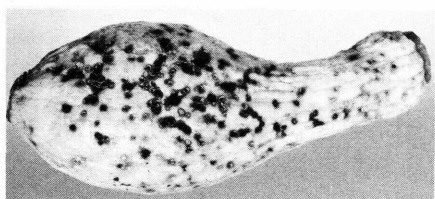
- Rotate crops; do not grow pumpkins, squashes, cucumbers, or melons on the same field oftener than once every 3 years.
- Treat seed with bichloride of mercury before planting (see p. 13).
- Spray plants with ziram, maneb, or captan; begin spraying early in the season; spray every 5 or 7 days.

Bacterial Wilt

Bacterial wilt is a widespread disease of cucurbits that sometimes causes severe damage to squashes. Pumpkins are susceptible to the disease but seem to be damaged less frequently than squashes. The disease is prevalent in the North Central and Northeastern States. It is spread by cucumber beetles.

Infection usually appears first in a single leaf, which hangs limp. Other leaves on the branch gradu-

⁴ 2,4-dinitro-6-(2 octyl) phenyl crotonate.



BN 1196

Figure 10.—Squash fruit showing typical spotting by the scab fungus.

ally wilt but remain green. The infection spreads to other branches and the plant finally withers and dies.

Fruits also are affected, but damage may not appear until they have been stored for some time. They develop slime-filled dark patches and decayed spots.

Some varieties of squash are resistant to bacterial wilt; Acorn, Butternut, Delicious, and Buttercup rarely are damaged.

To reduce losses in susceptible varieties, follow recommendations for control of cucumber beetles on page 16. Remove and destroy wilted plants as they appear.

Fusarium Root Rot

Fusarium root rot usually begins as a soft, mushy rot of the stem just above the soil surface. The infected area turns brown, and as rot progresses the stem may be covered by white or pinkish fungus growth. Infected plants wilt rapidly; large plants usually wilt in midseason. Infected fruits develop soft, water-soaked areas that later turn brown. Rot may progress until the entire fruit is destroyed.

Spraying or dusting is not effective for control of *fusarium* root rot. Crop rotation and seed treatment

are the best available means of reducing losses.

Choanephora Fruit Rot of Squash

This disease attacks the blossoms and young fruit of squash. Dense white fungus growth covers the blossoms; growth soon turns purplish black. When female flowers are infected, young fruits also decay and die.

Choanephora fruit rot causes especially heavy losses in rainy seasons. It is more destructive to plants on very moist soils than to plants on well-drained soils.

Crop rotation helps to prevent serious losses from this disease. Copper fungicides, zineb, or ziram applied as dusts or sprays give partial control. (See pp. 14 and 15.)



BN 1197

Figure 11.—Squash fruit covered with a dark growth of the fungus that causes *choanephora* rot.

Gummy Stem Blight or Black Rot

Infection on stems is called gummy stem blight; infection on fruit is called black rot.

Gummy stem blight sometimes girdles and kills seedlings. Water-soaked areas on stems of older plants turn into cracked brown cankers. Cankers ooze a gummy brown substance and become covered with minute black fruiting bodies. Cankered branches commonly wilt late in the season. Infected leaves have irregular brown spots that become covered with the dark spore-producing bodies.

Black rot causes loss of squashes and pumpkins in storage. Infected spots on fruits are dark and firm; they become water soaked and dotted with tiny dark fruiting bodies. The spots may produce a gummy substance.

Crop rotation is essential for reducing losses from black rot. Since the fungus may be seed borne, treat the seed with bichloride of mercury (see p. 13). Spraying or dusting plants in the field may reduce fruit rot there and in storage. Apply fixed

copper fungicides, ziram, or zineb as described on pages 14 and 15.

Miscellaneous Fruit Rots

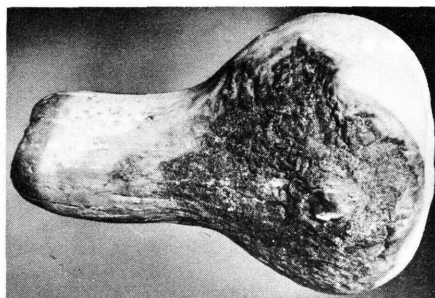
In addition to the fruit rots associated with bacterial wilt, root rot, choanephora rot, and black rot, a number of other rots of squashes and pumpkins are caused by bacteria and fungi; some of these cause little or no injury to other parts of the plants.

The symptoms of these rots vary from a watery, soft decay of the fruit to a dry rot of fairly firm texture. If caused by fungi, growth of the causal organism usually is present on the surface of the rotted fruit, and spores are produced that may infect other fruits in storage. Most of these rots occur both in the field and in storage, but they are most common in storage.

Infection of fruits is favored by injuries to the surface from rough handling, fluctuations of temperature in storage, and lack of heat and ventilation leading to sweating of the fruits in storage.

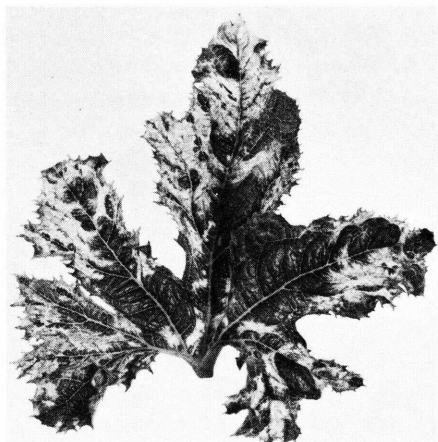
Mosaic

Four mosaic virus diseases cause serious losses of squashes. Cucumber mosaic virus infects squashes and pumpkins throughout the United States. Watermelon mosaic viruses 1 and 2 occur principally in the Southern, Southwestern, and Pacific Northwestern squash-growing areas. Squash mosaic virus is most prevalent in the Southwest. Mosaic damage is most common in Straight-neck and Crookneck summer squashes. Pumpkins also are susceptible to mosaic, but are not as



BN 1199

Figure 12.—Squash fruit showing symptoms of black rot. (Courtesy of Massachusetts Agricultural Experiment Station.)



BN 1198

Figure 13.—Squash leaf showing mottling and deformity caused by the cucumber mosaic virus.

severely affected. Mosaic viruses cause malformed and mottled leaves and frequently deformed, off-colored fruit. Plants are stunted and fruit yields are reduced.

Cucumber and watermelon mosaic viruses are spread by aphids (plant lice) and squash mosaic virus by cucumber beetles. Viruses live in perennial weeds. Squash mosaic virus, unlike cucumber and watermelon mosaic viruses, is carried in some of the seeds of infected plants.

Use virus-free seed. Control cucumber beetles and aphids where practicable. Destroy perennial weeds near the field. Remove and destroy diseased plants.

Curly Top

The virus disease curly top limits culture of squash and pumpkin in many areas west of the Rocky Mountains. Where it occurs, it also causes major losses on beets, beans, tomatoes, and some other vegetable crops.

Infected seedlings of pumpkin and squash soon die. Older plants are dwarfed; runners are shortened and turned up at the tips; leaves are yellowed, blistered, and curled at the edges. Many blossoms fail to set fruits, making the plants unproductive.

Curly top is spread by the beet leafhopper.

No satisfactory control is available for curly top. With squashes, the best way to reduce losses is to use the tolerant varieties Umatilla Marblehead and Yakima Marblehead.

Crop Rotation

Many of the soil-borne diseases can be controlled if no susceptible plants are grown in the soil oftener than once every 3 years. Many of the other cucurbits—watermelons, muskmelons, and cucumbers—are susceptible to the same diseases as pumpkins and squashes. Ask your county agricultural agent or your State agricultural experiment station to recommend other crops for use in the disease-control rotation.

Crop rotation is also useful for reducing damage by the root knot nematode. For further information, see "Root Knot," page 20.

Seed Treatment

Disinfectant

Many seed-borne diseases can be controlled by disinfecting the seed in a 1:1,000 solution of bichloride of mercury (corrosive sublimate) in water. *CAUTION: Bichloride of mercury is a deadly poison. Do not use treated seed as food or feed.*

The chemical is available from druggists in blue tablets or in powder form.

Prepare at least $1\frac{1}{2}$ quarts of solution for every pound of seed to be disinfected. For the proper strength of solution, use one tablet for each pint of hot water or dissolve 1 ounce of the powder in $7\frac{1}{2}$ gallons of hot water. Let the solution cool before using.

Prepare all bichloride of mercury solutions in glass, earthenware, or wooden containers; the chemical corrodes metal.

Treat seed as follows: Put seed in a loosely woven cloth bag; do not fill the bag over half full. Place the bag in the solution and stir the seeds to be sure they are all wetted. Soak the bag of seed for exactly 10 minutes; then remove the bag from the solution and wash the seed for 15 minutes in cold running water or in several changes of cold water. Remove the seeds from the bag and spread them in a thin layer to dry.

Do not use the same solution for more than two lots of seed.

Protectant

To reduce losses from damping-off, treat seed with a fungicide. Use dust of thiram, chloranil, captan, or dichlone at the rate recommended by the manufacturer. Place seed and dust in a tight container; put in no more than enough seed to half fill container. Shake the container 1 to 2 minutes to coat the seeds with dust. Then screen off the excess dust and plant the seed.

Application of Fungicides

Losses from leaf diseases and a number of fruit rots can be reduced by the application of fungicides. Good results can be obtained only if spraying or dusting begins before the disease is prevalent in the field and if the fungicide thoroughly covers the plants. Begin applications when the vines blossom. Follow directions given on fungicide container label.

Apply fungicides at intervals of 7 to 10 days. When the weather is dry, a 10-day interval is not too long; during periods of high humidity and rainy weather, a 7-day or even shorter interval is necessary.

Spraying generally is preferable to dusting, but the extensive vine growth of pumpkins and some varieties of squashes may make dusting the more feasible method of applying fungicides. If you use power equipment, the vines must be trained in some rows to allow passage of the machine.

For spraying, a conventional fixed-boom sprayer can be used. It should be capable of delivering 150 gallons per acre at 300 pounds pressure and should have three or four nozzles. Apply from 75 to 150 gallons of spray per acre. Young plants require less spray than older ones; pumpkins and vining varieties of squash require more than bush-type squashes.

For dusting, use a machine that delivers a steady, uniform cloud of dust. Apply 25 to 40 pounds of dust per acre. If possible, dust early in the morning or toward evening when the air is calm.

Fixed Copper Sprays

The fixed copper compounds include such preparations as basic copper sulfates, copper oxychlorides, copper oxychloride sulfate, and cuprous oxide. These compounds, sold under various trade names, can be used for control of leaf diseases and fruit rots of squashes and pumpkins. They cause less injury to the plants than is caused by bordeaux mixture.

Use fixed copper preparations in amounts that give $1\frac{1}{2}$ pounds of copper (calculated as metallic copper) to 100 gallons of water. The copper content of each preparation is shown on the label and the amount needed can be calculated from this. For example, 3 pounds of a compound containing 50 percent of copper is needed to give $1\frac{1}{2}$ pounds of copper in 100 gallons of water. With a compound containing 25 percent copper, 6 pounds would be needed.

Fixed Copper Dusts

Fixed copper dusts usually can be bought from dealers in agricultural supplies. A dust containing 5 percent of actual copper can be used.

Organic Fungicide Sprays

For a spray containing zineb, maneb, ziram, or captan, add 2 pounds of the commercial preparation to 100 gallons of water. To prepare nabam, add 2 quarts of the liquid fungicide to 100 gallons of water, then add to this 1 pound of zinc sulfate dissolved in water.

Prepare and use dinocap strictly according to the directions on the package.

INSECTS

Pumpkins and squashes often are severely damaged by insects or insect-transmitted viruses. No one insecticide will control all insects attacking these crops. For effective control, you must be able to identify the insects, select the proper insecticides, and apply them before damage is done.

The more important insect pests of pumpkins and squashes are the melon aphid, cucumber beetles, the squash bug, the squash vine borer, the pickleworm, leaf miners, and cutworms.

Description of Insects and Control Measures

Melon Aphid

The melon aphid is a small, louse-like insect that obtains its food by sucking plant juices. It feeds on the underside of the leaves, and its presence often is first shown by a slight curling or cupping of leaves. An infestation may start when a few winged females fly to pumpkin or squash plants from one of the aphids' other food plants. These females start new colonies, which can spread over entire plants and throughout the field. In heavy infestations the leaves curl and lose color, and the affected plants die.

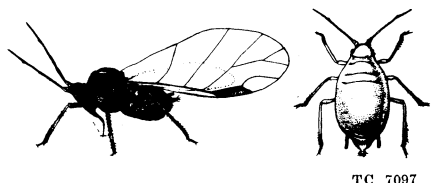


Figure 14.—Winged and wingless adults of the melon aphid.

The aphids also spread such diseases as mosaic from plant to plant.

The melon aphid is hard to control; once it is established in a planting it may destroy the crop.

Examine pumpkin or squash plants frequently for aphids; apply diazinon, endosulfan, or parathion, before the infestation becomes widespread. Repeat the insecticide application until the insect is brought under control.

Cucumber Beetles

There are several kinds of cucumber beetles, and they vary in importance in different parts of the country. They are about 3/16 of an inch long and greenish-yellow with black stripes or spots. The striped cucumber beetle has 3 longitudinal black stripes down the back while the spotted cucumber beetle has 12 black spots. The other species are similar in appearance. The striped cucumber beetle is most abundant east of the Rocky Mountains. The spotted cucumber beetle sometimes becomes a menace to pumpkin and squash in the same areas. Both species occur in the South and Southwest. The banded cucumber beetle, which occurs in about the same area, is sometimes more numerous than the other two. The western striped cucumber beetle and the western spotted cucumber beetle cause injury in the Rocky Mountain and Pacific Coast States.



EPQ 2010

Figure 15.—The striped cucumber beetle.



TC 7111

Figure 16.—The spotted cucumber beetle.

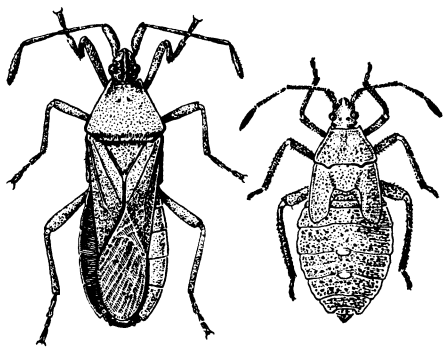
Cucumber beetles frequently attack the plants as soon as they come up and may kill them. As the plants grow, the beetles feed upon the leaves, flowers, tender shoots, and fruits. The stalks may be girdled near the soil surface. These insects frequently spread bacterial wilt and mosaic disease. The larvae feed on the roots and underground part of the stalks.

Cucumber beetles can be controlled with malathion, methoxychlor, carbaryl, or parathion, provided the material is applied as soon as the insects appear. If the beetles are abundant when the plants come up, a delay of only 1 day may result in the loss of the planting. The most critical period is between the time the seedlings come through the ground and the time the plants begin to form vines. Also be on the alert for first signs of injury to the fruits.

Apply a light, even coating of the insecticide over the entire plant. Be sure to apply insecticide where the stalk emerges from the soil. The beetles often congregate and hide at this point. Repeat the application every week as long as the insects are present in injurious numbers.

Squash Bug

The squash bug may damage pumpkin and squash throughout the United States. This insect feeds by sucking the sap from the leaves.



EPQ 2010

Figure 17.—Adult and nymph of the squash bug.

The injured leaves wilt rapidly and become black and crisp. Small plants may be killed outright. Some of the leaves or runners of older plants may be killed. In a severe infestation fruit production is reduced or prevented.

The adult bugs are dark brown, hard bodied, narrowly shield shaped, two-thirds of an inch long, and nearly one-fourth of an inch wide; they have well-developed wings. They lay eggs on the undersides of the leaves. The eggs are shiny, oval, and yellow; they change to brown before they hatch. The newly hatched bugs, or nymphs, are green, soft bodied, and wingless. In later stages they turn gray and develop wing pads.

None of the insecticides now available is completely satisfactory for the control of the squash bug. Fairly effective results can be obtained, however, with parathion or carbaryl. Treat both upper and lower sides of the leaves as soon as any eggs, nymphs, or adults of the squash bug are seen on the plants. Repeat once a week while the insects are numerous.

Squash Vine Borer

The squash vine borer may damage pumpkin and squash in areas east of the Rocky Mountains. When fully grown this insect is nearly an inch long and one-fourth of an inch thick, and has a brown to black head. It enters the stem of the plant just above the soil surface and bores up the stem; it also bores into the vines, often causing the plants to wilt. Sometimes the vines are girdled or severed at their base. The fruits are occasionally attacked.

To control the squash vine borer, apply lindane, carbaryl, naled, or endosulfan to the stems and vines near the base of the plant. Make the first application when the runners develop and repeat at weekly intervals during the growing period.

Pickleworm and Melonworm

The pickleworm and its close relative the melonworm are serious pests of squash. The melonworm also infests pumpkin, but this crop is seldom infested by the pickleworm. These insects cause the most serious damage during summer and fall in the Gulf and South Atlantic States. They frequently cause considerable damage in States adjoining these areas, and occasionally are serious pests as far west as Oklahoma and Nebraska and as far north as Iowa and Connecticut.



TC 7130

Figure 18.—The squash vine borer.

The insects feed on squash and other cucurbits throughout the winter in extreme southern Florida and Texas. They gradually spread northward each year. Except in southern Florida and Texas, their injury to pumpkin and squash is most serious during the summer and fall. Spring plantings escape damage in most areas in which the insects occur.

Young pickleworms are yellowish white and have numerous dark spots over the entire body; these spots disappear before the larvae are full grown. Young melonworms are greenish yellow with two white lines that run the full length of the body; these lines remain until just before the larvae are full grown. Mature

pickleworms and melonworms are about three-fourths of an inch long.

The eggs of both insects are laid singly or in small clusters among the hairs on flower and leaf buds, small fruits, and young leaves. Young pickleworms feed on the surfaces where the eggs are laid, but soon tunnel into the flowers, terminal buds, stalks, vines, and fruits. Melonworms usually feed only on the foliage.

To control the pickleworm and the melonworm on summer squash apply lindane or carbaryl. Make the first application of either insecticide when the young larvae appear in the blossoms and terminal buds. After pickleworms appear on summer squash it will be necessary to repeat application every week. For further information on the pickleworm see Leaflet 455, "The Pickleworm: How To Control It on Cucumber, Squash, Cantaloup, and Other Cucurbits," available from the U.S. Department of Agriculture, Washington, D.C. 20250; send your request on a postcard. Include ZIP code in your address.



TC 7344

Figure 19.—Pickleworms feeding in squash flower.

Leaf Miners

In the extreme southern parts of the country, tiny yellow maggots of small black and yellow flies eat irregular winding, white tunnels in squash leaves. These maggots are known as leaf miners. They usually are controlled by tiny, wasplike parasites, but may cause considerable damage. Leaf miners are controlled by applying parathion or diazinon as needed.

Cutworms

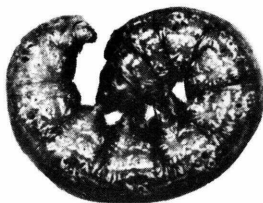
Cutworms are stout, soft-bodied, smooth caterpillars, up to $1\frac{1}{4}$ inches long that hide in the soil during the day and feed on plants at night. There are many species varying from dull gray to brown or black. Some are spotted or striped. They usually curl when disturbed. Some of the common species are the variegated cutworm, the granulate cutworm, and the black cutworm. Cutworms sometimes are very destructive to small plants of pumpkin and squash. They can be controlled by applying carbaryl or parathion on the plants or by applying toxaphene to the soil before planting.

Application of Insecticides

Before using insecticides read carefully the "Precautions" on pages 20 and 21. Insecticides may be applied as either dusts or sprays as preferred by the grower.

Buy dusts that are ready for use and apply at a rate of about 25 pounds per acre when the air is relatively calm and the humidity high.

Prepare sprays by mixing either wettable powders or emulsifiable concentrates with water. From 20 to 150 gallons of spray per acre usually is needed for ground sprayers and 4 to 6 gallons per acre for aircraft sprayers. The amount of water applied does not appreciably affect the amount of active insecticide needed for control, so long as suitable application equipment is used. However, wettable powders



TC 7191

Figure 20.—The black cutworm.

may clog nozzles of low-gallonage sprayers and are not recommended for application from aircraft equipment.

Adjust nozzles of dusters and sprayers so the insecticide reaches all parts of the plants and so they deliver sufficient material to give a thorough distribution throughout the foliage.

The following tabulation gives the maximum amount of active ingredient of each insecticide that should be used per acre; smaller quantities may be adequate under some conditions.

<i>Insecticide</i>	<i>Pounds of active ingredient per acre</i>	
	<i>In sprays</i>	<i>In dusts</i>
Diazinon.....	$\frac{1}{2}$	1
Lindane.....	$\frac{1}{4}$	$\frac{1}{4}$
Malathion.....	$1\frac{3}{4}$	$1\frac{3}{4}$
Methoxychlor.....	$1\frac{1}{2}$	$1\frac{1}{2}$
Parathion.....	$\frac{1}{4}$ to $\frac{1}{2}$	$\frac{1}{4}$ to $\frac{1}{2}$
Carbaryl.....	$\frac{1}{2}$ to 1	$\frac{1}{2}$ to 1
Endosulfan.....	$\frac{1}{2}$	1
Toxaphene.....	2	2
Naled.....	$1\frac{1}{2}$	$1\frac{1}{2}$

Diazinon, lindane, malathion, parathion, endosulfan, and toxaphene are available in dusts, wettable powders, and emulsifiable concentrates but parathion emulsions may injure plants slightly. Toxa-

phene may cause severe injury to the foliage of pumpkin and squash and should not be used after these crops are planted. Methoxychlor and carbaryl are available in wettable powders and dusts.

The use of lindane on winter squash may have a slight undesirable effect on flavor. Lindane should not be used on squash or pumpkin foliage in fields to be planted within 2 years to potato or other root crops, or peanuts, or it may adversely affect their flavor.

ROOT KNOT

Root knot is caused by minute eelworms or nematodes (*Meloidogyne* spp.) that attack the roots of squashes, pumpkins, and other vegetables. These eelworms cause swellings, or galls, on the roots. Aboveground symptoms of root knot are lack of vigor, stunting of the plants, and wilting during the hot part of the day. Root knot is often very serious in sandy soils of the South.

Whenever possible, use land that is free of root knot nematodes. Nematode populations in infested land can be reduced by keeping the field free of plants that are attacked by the nematodes. For example, if you grow hairy vetch, small grains, various crotalaria, or peanuts for 2 years, you can clean up infested land to such an extent that it can be used for growing a crop of pumpkins or squashes.

Root-knot nematodes also can be controlled successfully by the use of nematocides, or soil fumigants, which are injected into the soil.

When using nematocides, follow the manufacturer's directions exactly. Ask your county agricultural agent or your State agricultural experiment station for advice as to the best method of application and possible harmful effects. Variations in soils and climate may affect the action of the nematocides.

The nematocides most commonly used for soil to be planted to squash or pumpkins contain dichloropropene, ethylene dibromide, or dibromochloropropane as the active ingredient.

They are applied 2 weeks or more before planting. Special applicators are used to inject them into the soil to a depth of about 8 inches. The whole field may be fumigated, fumigant may be injected in a single stream to the row where seed is to be planted, or the fumigant may be spot injected in marked hills only. This last method is the most economical, but it is practical only for treating small areas.

PRECAUTIONS

Pesticides used improperly may cause injury to man and animals. Use them only when needed and handle them with care. Follow the directions and heed all precautions on the labels.

Keep pesticides in closed, well-labeled containers in a dry place. Store them where they will not contaminate food or feed, and where children and animals cannot reach them.

When handling a pesticide, wear clean, dry clothing.

Avoid repeated or prolonged contact of pesticide with your skin.

Wear protective clothing and equipment if specified on the container label. Avoid prolonged inhalation of pesticide dusts or mists.

Avoid spilling pesticide concentrate on your skin, and keep it out of your eyes, nose, and mouth. If you spill any on your skin or clothing, remove contaminated clothing immediately and wash the skin thoroughly. Launder the clothing before wearing it again.

After handling a pesticide, do not eat, drink, or smoke until you have washed your hands and face. Wash any exposed skin immediately after applying a pesticide.

Do not apply pesticides to flowering plants when bees are in the field.

Avoid drift of pesticide to nearby wildlife habitats, bee yards, crops, or livestock. Do not apply pesticides under conditions favoring drift from the area to be treated.

Many pesticides are highly toxic to fish and aquatic animals. Keep pesticides out of all water sources such as ponds, streams, and wells. Do not clean spraying equipment or dump excess spray material near such water.

Do not apply pesticides to plants during hours when honey bees and other pollinating insects are visiting them.

Dispose of empty pesticide containers at a sanitary land-fill dump, or crush and bury them at least 18 inches deep in a level, isolated place

where they will not contaminate water supplies.

Zineb and nabam should not be applied to summer squash within 7 days of harvest. Dinocap should not be used on summer or winter squash within 7 days of harvest.

Parathion is highly toxic and may be fatal if swallowed, inhaled, or absorbed through the skin. It should be applied only by a person who is thoroughly familiar with its hazards and who will assume full responsibility for safe use and enforce precautions prescribed by the manufacturer. Do not apply parathion to squashes within 15 days, or to pumpkins within 10 days before harvest.

Diazinon, lindane, endosulfan, naled, and toxaphene can be absorbed directly through the skin in harmful quantities.

Do not apply diazinon to winter squash within 3 days, or to summer squash within 7 days before a harvest. Do not apply diazinon to pumpkin. Do not apply naled to summer squash within 4 days, or to winter squash or pumpkins within 7 days of harvest. Do not apply endosulfan, lindane, methoxychlor, or carbaryl within 24 hours before harvest. Do not use malathion on pumpkins within 3 days or on squashes within 1 day before a harvest. Do not apply toxaphene after planting squashes and pumpkins.



Use Pesticides Safely
FOLLOW THE LABEL

U.S. DEPARTMENT OF AGRICULTURE